Summary of Lahontan Reservoir Water Quality, 2003-05

December 2012

INTRODUCTION

Nevada Division of Environmental Protection undertook a 3-year (2003-05) monitoring program to characterize current conditions and collect data for possible future standards revisions. In a 2007 document, NDEP discusses some of the key findings as a result of this monitoring effort. This fact sheet summarizes that report plus provides additional information.

BACKGROUND

Six sites on the reservoir were monitored during 2003-05 (Figure 1). Each site was sampled about once a month from about May through October. Grab samples were typically taken from three depths, epilimnion (near surface), metalimnion (mid-depth), and hypolimnion (lower depth), and analyzed in the laboratory for a suite of routine parameters such as nitrogen , phosphorus, chlorophyll-a, total dissolved solids, total suspended solids, and turbidity. A number of metals and other toxics were also included in the analyses, such as arsenic, boron, copper, iron, lead, etc. Dissolved oxygen and temperature profiles (throughout the water column) were also generated at each of the sites during each sampling event. Secchi disk readings (a measure of lake clarity) were also taken during each event.

Lahontan Reservoir water quality is affected by the quantity and quality of inflows from the Carson River and the Truckee Canal. During the 2003-05 period, annual inflows varied from 306,500 to 364,540 acre-feet (AF) with all three years falling below the 1967-2005 average and median (Table 1). While Lahontan Reservoir experienced similar total inflows in 2003 (353,000 AF) and 2005 (364,500 AF), there was a significant difference in the contribution from the Carson River and Truckee Canal. The Carson River accounted for about 56% of the total inflow in 2003 and about 70% in 2005. The 2005 Carson River inflows were about 65% higher than the 2003 inflows. The Carson River inflows in 2005 were about 2.5 times higher than the 2004 inflows.

Figure 1. Lahontan Reservoir Monitoring Sites

Table 1. Surface Water Inflows to Lahontan Reservoir, 2003-05 (in acre-feet)

Year	Carson River	Truckee Canal	Total Inflow
2003	198,100	154,900	353,000
2004	128,200	178,300	306,500
2005	323,700	40,840	364,540
Historic Avg. 1967-2005	289,000	120,900	410,400
Historic Median 1967-2005	257,600	121,900	390,800

MONITORING RESULTS

Nutrients (phosphorus, nitrogen) are some of the key constituents of interest when describing the water quality of Lahontan Reservoir. Phosphorus and nitrogen support the growth of algae which can affect the beneficial uses of the reservoir, such as recreation and aquatic life. High algae levels decrease the aesthetic value of the reservoir for swimming, boating, and water skiing. While some algae is needed to provide food for aquatic life, including fish, too much can be detrimental and can lead to depressed dissolved oxygen levels in the lower depths of the reservoir.

During the period 2003-05, the total phosphorus levels were consistently above the water quality standard (0.06 mg/l) at all six monitoring sites (Figure 2). In general, the total phosphorus concentrations were highest near the Carson River inflow (LR1A) and lowest near the dam (LR5). Total nitrogen concentrations followed similar trends with the highest levels near the river inflow and the lowest near the dam (Figure 3).

In development of the total phosphorus standard (0.06 mg/l), NDEP relied upon a chlorophyll-a (pigment in algae that is often used as a surrogate for algae biomass) target of 10 ug/l. A chlorophyll-a threshold of 10 µg/l was selected as some research has shown that lakes and reservoirs with chlorophyll-a levels above this value can have excessive algae growth that significantly impair beneficial uses. Like phosphorus and nitrogen, chlorophyll-a followed similar trends with high levels near the Carson River inflow and low levels near the dam (Figure 4). Conditions exceeding the chlorophyll-a target of 10 ug/l were most common in the upper basins of the reservoir nearest Carson River.

Figure 2. Total Phosphorus Levels

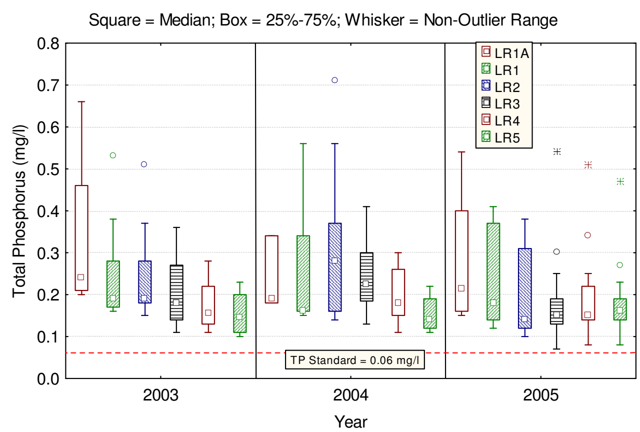


Figure 3. Total Nitrogen Levels

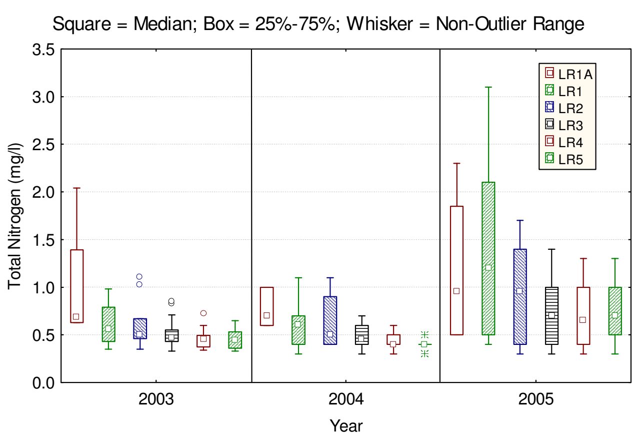
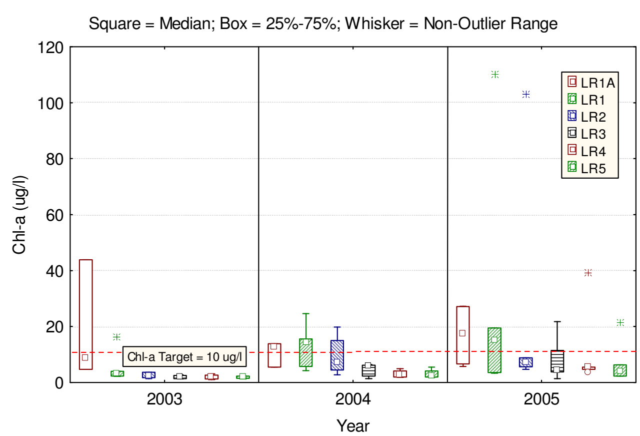


Figure 4. Chlorophyll-a Levels in Epilimnion



Water clarity is another characteristic to consider when evaluating the health of Lahontan Reservoir. Certain levels of clarity are needed to support aquatic life and water recreation uses. Secchi disk depth is a good indicator of those water quality conditions that affect clarity, such as total suspended solids (TSS), turbidity, chlorophyll-a (algae levels). In each of the three years, lake clarity was generally the lowest near the Carson River inflow (LR1A) and the highest near the dam (LR5) (Figure 5). Similar relationships were experienced with TSS and turbidity levels (Figures 6 and 7). As could be expected, Secchi disk depths were strongly related to TSS and turbidity as shown in Figures 8 and 9.

While there are currently no Secchi disk depth water quality standards set for Lahontan Reservoir, standards have been set for TSS and turbidity standards, 50 mg/l and 50 NTU, respectively. During 2003-05, there were a sufficient number of TSS and turbidity standard exceedances (generally more than 10% of the samples exceeding the standard) to place Lahontan Reservoir on the 303(d) List of impaired waters.

Figure 5. Secchi Depth Readings

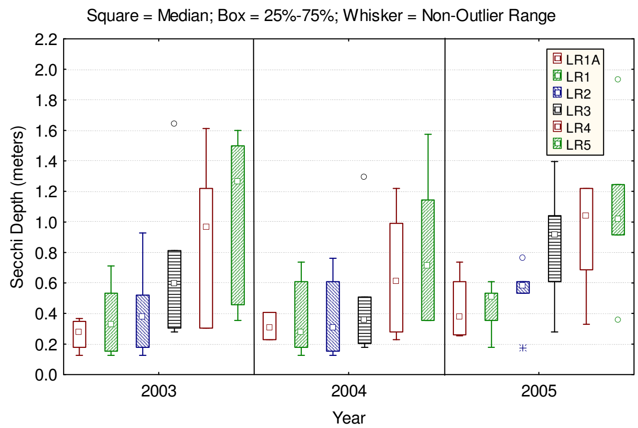


Figure 6. Total Suspended Solids

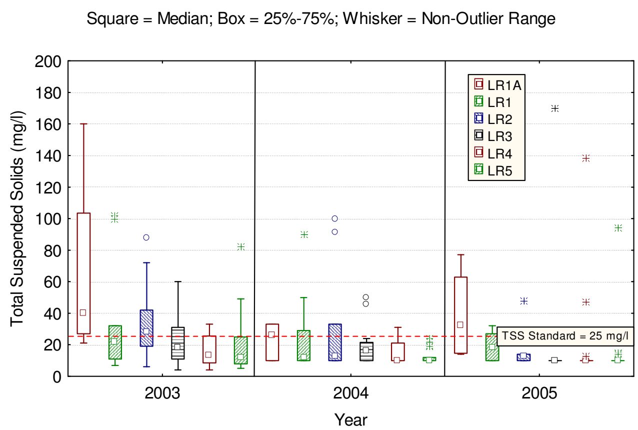


Figure 7. Turbidity

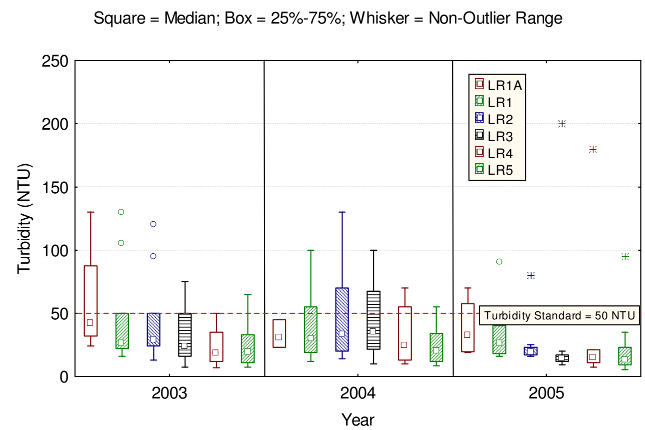


Figure 8. Lahontan Reservoir, Secchi Depth vs. Total Suspended Solids (2003-05)

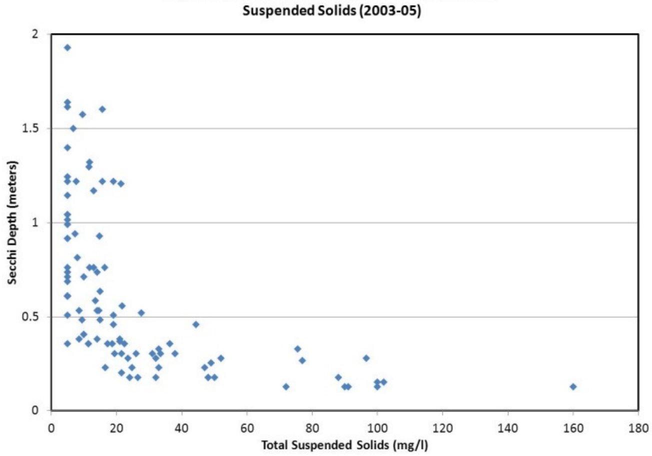
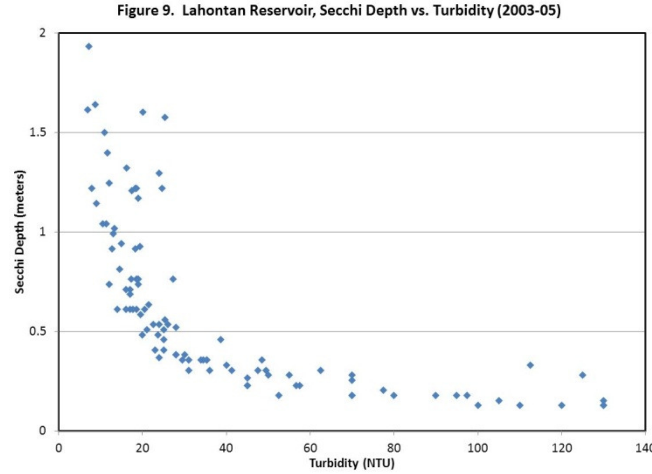
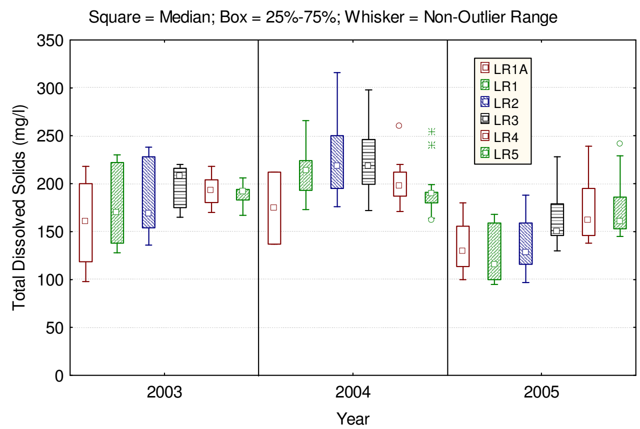


Figure 9. Lahontan Reservoir, Secchi Depth vs. Turbidity (2003-05)



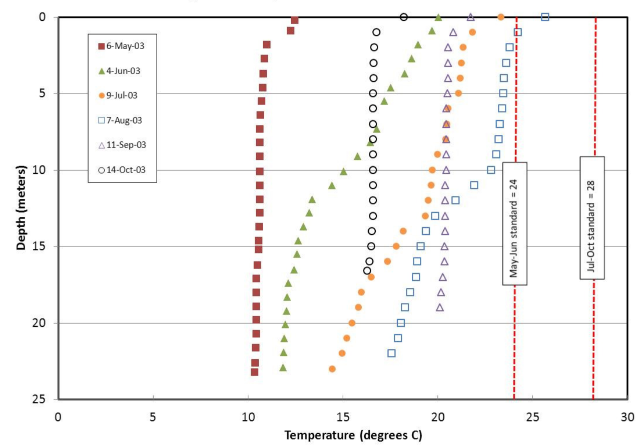
Total dissolved solids (TDS) standards have been set for Lahontan Reservoir at 500 mg/l for the protection of municipal or domestic supplies. All samples collected during 2003-05 had TDS levels below this standard (Figure 10). Lower TDS levels occurred in 2005 compared to 2003-04, likely due to the higher inflows.

Figure 10. Total Dissolved Solids



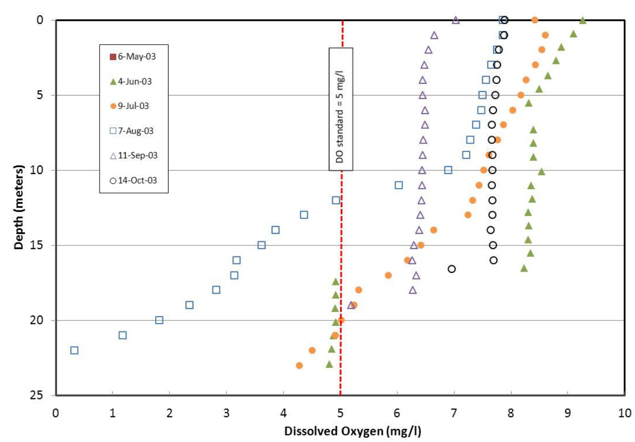
Temperature standards have been set for Lahontan Reservoir as follows: November-March < 11° C; April-June < 24° C; July-October < 28° C. The data collected during 2003-05 indicated that the temperature criteria were met on each of the monitoring dates. The highest temperatures typically occurred in late July to early August. When evaluating reservoir temperature conditions, it is important to account for variability throughout the water column. Generally, lakes and reservoirs have higher temperatures near the surface and lower temperatures in the depths of the waterbody. Figure 11 depicts the variability of temperatures at LR5 over the course of the 2003 monitoring. By the time of the August 7, 2003 measurements, the reservoir at LR5 had become thermally stratified with: a) relatively uniform warmer temperatures in the upper water (<10 meters), b) temperature transition zone (10 to 14 meters), and c) relatively uniform cooler temperatures in the lower water (>14 meters). These three regions are commonly referred to as: a) epilimnion, b) metalimnion, and c) hypolimnion. This stratification phenomenon occurred during some of the months at most of the monitoring sites during the 2003-05 period.

Figure 11. Temperature Profiles at LR5 - 2003



Dissolved oxygen (DO) levels need to be maintained above certain thresholds to support aquatic life. Like temperature, DO levels can be highly variable throughout the water column and over time (Figure 12). During 2003 at LR5, violations of the DO standards occurred only at depths greater than about 12 meters (in the metalimnion and hypolimnion). Depressed DO levels in the deeper zones of lake and reservoirs are common in waterbodies that become stratified. At the beginning of the summer, the hypolimnion will usually contain more DO because colder water holds more oxygen than warmer water. However, over time, an increased number of dead organisms (algae, etc.) from the epilimnion sink to the hypolimnion and are decomposed resulting in reduced oxygen levels.

Figure 12. Dissolved Oxygen Profiles at LR5 - 2003



Algae species identification is an important consideration when evaluating conditions in a lake or reservoir. While chlorophyll-a levels are one measure of waterbody health, the types of algae in a waterbody are also key indicators of potential problems. The key concern is associated with the occurrence of a species of algae referred to as cyanobacteria (sometimes called blue-green algae). Unlike other green algae, cyanobacteria can obtain the nitrogen it needs from the atmosphere, and possibly dominate the algal population. Cyanobacteria can cause problems by producing toxins that can be detrimental to aquatic life in the waterbody, and to human recreating on the waterbody. However, it is important to note, the presence of cyanobacteria is not a predictor of the presence of toxins. As part of the 2003-05 monitoring effort, algae species were identified for the 2004 samples. The data indicate that cyanobacteria were present at each of the monitoring sites and sometimes dominated the algal population.